MARKED-UP CLAIMS WITH AMENDMENTS SHOWN

(1). A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have a dynamic hardness value from 26 to 30, which is obtained by the following formula:

$DH=KxPmax/hmax^2$,

wherein DH is dynamic hardness, K is a constant value based on an indentator inherent to the liquid crystal display, Pmax is maximum load, and hmax is the total maximum variation obtained by adding elastic deformation and plastic deformation.

(2). A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of

photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=KxPmax/hr^2$,

wherein HV is hardness of plastic deformation, K is a constant value based on an indentator inherent to the liquid crystal display, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading.

(3). A liquid crystal display comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,

wherein said spacers have dynamic hardness value (DH) from 26 to 30, which is obtained by the following formula:

$DH=KxPmax/hmax^2$,

wherein DH is dynamic hardness, K is a constant value based on an indentator inherent to the liquid crystal display, Pmax is maximum load, and hmax is the total maximum variation obtained by adding elastic deformation and plastic deformation,

and wherein said spacers have a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=KxPmax/hr^2$,

wherein HV is hardness of plastic deformation, K is a constant value based on an indentator inherent to the liquid crystal display, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading.

(4) [A] The liquid crystal display of Claim 1, [comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,] wherein said spacers have elastic coefficient from 100 to 500 kg/mm^2.

(5)[A] The liquid crystal display of Claim 1 [comprising:

first and second substrates each having a display and a non-display region and being disposed to face each other;

spacers disposed in the non-display region of at least one of the first and the second substrates and being formed of photosensitive resin which regulates a cell gap between the first and the second substrates; and

liquid crystal sandwiched between the first and the second substrates,] wherein said spacers have linear expansion coefficient which is nearly equal to the coefficient of volume expansion per unit area of the liquid crystal.

(13) The liquid crystals according to claim 1 wherein said spacers have the ratio of one side of the upper to one side of the lower bottom for a rectangle or the ratio of the diameter of the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%.

(14) The liquid crystals according to claim 2 wherein said spacers have the ratio of one side of the upper to one side of

the lower bottom for a rectangle or the ratio of the diameter of the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%.

(15) The liquid crystals according to claim 3 wherein said spacers have the ratio of one side of the upper to one side of the lower bottom for a rectangle or the ratio of the diameter of the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%.

(16) The liquid crystals according to claim 4 wherein said spacers have the ratio of one side of the upper to one side of the lower bottom for a rectangle or the ratio of the diameter of the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%.

(17) The liquid crystals according to claim 5 wherein said spacers have the ratio of one side of the upper to one side of the lower bottom for a rectangle or the ratio of the diameter of the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%.

(18) The liquid crystals according to claim 6 wherein said spacers have the ratio of one side of the upper to one side of the lower bottom for a rectangle or the ratio of the diameter of

the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%.

(19) The liquid crystals according to claim 7 wherein said spacers have the ratio of one side of the upper to one side of the lower bottom for a rectangle or the ratio of the diameter of the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%.

(20) The liquid crystals according to claim 12 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(21) The liquid crystals according to claim 13 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(22) The liquid crystals according to claim 14 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(23) The liquid crystals according to claim 15 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(24) The liquid crystals according to claim 16 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(25) The liquid crystals according to claim 17 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(26) The liquid crystals according to claim 18 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(27) The liquid crystals according to claim 19 wherein said spacers have the length of one side of the upper bottom[, which is] equal to one side of the lower bottom [and a horizontal surface in the position] decreased by certain ratio from the maximum height of said spacers, or the diameter of the upper bottom[, which is] equal to that of the lower bottom decreased by said ratio from the maximum height of said spacers.

(29). The method according to claim 28 wherein said selecting of a photosensitive resin comprises choosing a photosensitive resin based on at least one of the group consisting of:

(a) a dynamic hardness value from 26 to 30, which is obtained by the following formula:

$DH=KxPmax/hmax^2$,

wherein DH is dynamic hardness, K is constant, Pmax is maximum load, and hmax is the total maximum variation obtained by adding elastic deformation and plastic deformation;

(b) a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=KxPmax/hr^2$,

wherein HV is hardness of plastic deformation, K is constant, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading;

(c) dynamic hardness value from 26 to 30, which is obtained by the following formula:

$DH=KxPmax/hmax^2$,

wherein DH is dynamic hardness, K is a constant value based on an indentator inherent to the liquid crystal display, Pmax is maximum load, and hmax is the total maximum variation obtained by adding elastic deformation and plastic deformation and wherein said spacers have a hardness value of plastic deformation (HV) from 38 to 46, which is obtained by the following formula:

$HV=KxPmax/hr^2$,

wherein HV is hardness of plastic deformation, K is said constant, Pmax is maximum load, and hr is variation when the tangent in the maximum variation point of a curb has no load in the case of unloading;

(d) an elastic coefficient from 100 to 500 kg/mm^2; a linear expansion coefficient which is nearly equal to the coefficient of volume expansion per unit area of the liquid crystal;

(e) the ratio of one side of the upper bottom to one side of the lower bottom for a rectangle or the ratio of the diameter of the upper bottom to [that of] the diameter of the lower bottom for circular shape of from 50 to 90%; and

(f) a column occupancy ratio from 0.05 to 0.86%, which is expressed as follows:

Column occupancy ratio=(Lower bottom area of column×column density/pixel area)×100

Column density: Total number of columns/total number of pixels.

REMARKS

Claims 1-29 are currently pending. The Examiner has rejected Claims 1-3, 13-27 and 29 under 35 USC §112 as indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention; and, Claims 1-29 under 35 USC §103 as unpatentable over the combined teachings of Shioda and Kajita, et al. For the reasons set forth below, Applicants respectfully submit that Claims 1-29 are definite and patentable over the cited prior art.

In response to the rejection of claims under 35 USC §112, Applicants have submitted amendments to the language of the rejected claims. Specifically, the Applicants have amended Claims 1-3 and 29 to include a more specific recitation of the constant K, as a value based on an indentator inherent to the liquid crystal display (see: Specification page 7, lines 8-9). The constant K is a value which is well-understood by those having skill in the relevant art. For example, the cited Shioda patent describes (at Col. 14, lines 43 et seq) the measurement of dynamic hardness using an indenter attachment (see, Col. 14, line 57) which would have its own value of K for external calibration. Similarly, the cited Kajita patent details measuring the integrity of liquid crystal displays using microcompression testers (see: Col. 21, line 43, et seq) having K constant values

built into the test conditions and calibrations. Clearly the terms which are used in the pending claims are terms of the art which would have distinct and definite meaning to one having skill in the art. Based on the amendments and the teachings of the references, Applicants respectfully request withdrawal of the 112 rejections of Claims 1-3 and 29.

With regard to the Examiner's rejection based on the use of the term "ratio of the diameter of the upper bottom to that of the diameter" in Claims 13-19 and 29, Applicants respectfully point out that the language of the claims has been amended to parallel the language found on page 10, paragraph 2 of the Specification. Applicants believe that the amended language is definite; and, Applicants request withdrawal of the rejections of Claims 13-19 and 29 under 35 USC 112.

Finally, in response to the rejection of the language of Claims 20-27 and 29 under 35 USC 112, Applicants have amended the language of those claims to recite the structural limitations as detailed from the bottom of page 10 through page 11 of the Specification and in Figure 2B. Again, Applicants believe that the amendment language addressed the Examiner's concerns and removes any basis for rejection under 35 USC 112.

Claims 1-29 have been rejected under 35 USC §103 as unpatentable over the combined teachings of the Shioda and Kajita patents. Applicants first note that the Examiner has based the rejections on the prior claim language, stating that the

vagueness of the K value (for Claims 1-3, and 29) as arbitrarily selected would be inherently met by any reference. Applicants respectfully request reconsideration of the rejections, in light of the express teachings from the Specification and the amendments to the claims. Clearly the claims recite a specific structure wherein the spacers have physical characteristics which are neither taught nor suggested by the cited patents.

In addition, the Examiner has stated that the cited patents teach the use of elastic coefficient and linear expansion coefficient as set forth in Claims 4 and 5. By this Amendment, Claims 4 and 5 have been amended to depend from Claim 1, which recites additional limitations not taught or suggested by the cited art.

As to the 103 rejections of Claims 6-11, Applicants note that the language of the claims recites a column occupancy ratio range, but also provides an express formula for arriving at a column density based on the area of the columns and the pixel area. Therefore, while a range is stated, it is modified by the formula. The cited Shioda patent teaching of a volume density range is not modified by teachings regarding column density as a function of the areas. Absent some teachings in Shioda which would lead one skilled in the art to modify a ratio range with a specific formula for arriving at an actual ratio of certain-size columns in a defined pixel area, it cannot be maintained that Shioda obviates the claim language.

With respect to Claims 12-27, Applicants note that the language of the claims has been amended. Further, Applicants argue that even if the Examiner's statement, that it is "well known in the art that the sizes, position and number of spacers are determined in accordance with the rigidity of the liquid crystal panel", such would not obviate the substantially more specific claim language of specific relationships between the dimensions of the upper and lower spacer surfaces. Absent some citation of a reference which teaches or suggests those ratios/relationships, it cannot simply be concluded that the specific relationship language is obvious.

Applicants respectfully remind that Examiner that obviousness can only be established by combining or modifying teachings of the prior art to produce the claimed invention when there is some teachings, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one or ordinary skill in the art (*In re Fine,* 837 F. 2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Since neither the Shioda nor the Kajita patent teaches or suggests the inventive spacer structures as claimed, and no other teaching, suggestion, or motivation has been provided, it cannot be maintained that the claim language is obvious.

The Examiner has also noted that the priority document referenced in the Declaration has a different number than the priority document from which the present application claims priority. The certified copy which was provided to the Patent Office included both the application number and the publication number for the same Japanese application. Applicants respectfully assert that the two numbers both refer to the same original Japanese patent application. Applicants will, however, execute a new Declaration if it becomes necessary to do so. It is respectfully requested that the Examiner contact the undersigned attorney to discuss the disposition of this issue.

Based on the foregoing amendments and remarks, Applicants request entry of the amendments, withdrawal of the rejections, and issuance of the claims.

Respectfully submitted,
T. Koseki, et al

By: Anne Vachon Dougherty
Anne Vachon Dougherty
Attorney for Applicant
Reg. No. 30,374